

## THE GASTEROMYCETES OF AUSTRALASIA.

### ix. KEYS TO THE GENERA AND SPECIES OF THE LYCOPERDACEAE.

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The writer would limit the Lycoperdaceae to those genera possessing a non-stipitate, two- or four-layered peridium, copious capillitium, and long-sterigmate, 4- or 8-spored basidia. The limits of the family have been much greater in the past, as the following classifications will show, but as our knowledge of the development and structure of the various genera have broadened, so the limits of the family have been narrowed.

Details of the various classifications which have been proposed are of little other than historical interest today, to the student of this group, but a few are given here to indicate the diversities of opinion held by different authors, as to the position and affinities of the genera included in the Lycoperdaceae.

Commencing with Persoon's *Synopsis Methodica Fungorum*, 1801 (the starting-point of Modern Nomenclature in the Gasteromycetes), we find he divides the Fungi as under (details of the Gasteromycetes only are given):—

<sup>1</sup>Class I. ANGIOCARPI: Fungi closed, or bearing very numerous spores internally.

Order 1. Sclerocarpi.

2. Sarcocarpi. Fungi fleshy stuffed. *Sphaerobolus*, *Thelebolus*.

3. Dermatocarpi. Fungi membranous, tough, internally powdery.

†Trichospermi. Seed powder mixed with threads. 13. *Batarrea*.

14. *Geastrum*.<sup>2</sup> 15. *Bovista*. 16. *Tulostoma*. 17. *Lycoperdon*.

18. *Scleroderma* (Genera 19-27 are now placed in a separate group, the Myxomycetes).

††Gymnospermi. Seed powder without threads.

†††Sarcospermi. Fructifications abundant, fleshy. 38. *Cyathus*.

Class II. GYMNOCARPI: Fungi fleshy. Seeds (few) borne in an open receptacle.

Order 4. Lytothecii. Fertile membrane at length mucilaginous. 39. *Clathrus*.

40. *Phallus*.

5. *Hymenothecii* (*Hymenomycetes*).

6. *Naematothecii* (*Hyphomycetes*).

As this and other classifications of that period are not in use today, the many others may be omitted, and attention paid only to those which have been in general use in recent years. Perhaps the best known of these is that followed in Saccardo's *Sylloge Fungorum*, Vol. 7, 1888, where the Lycoperdaceae is arranged as under

<sup>1</sup>Thanks are due to Miss Wakefield, Kew Herbarium, for a translation of Persoon's classification. Unfortunately this work is not procurable in New Zealand.

<sup>2</sup>Genera included by the writer in the Lycoperdaceae are italicized; those excluded by him, or not present in Australasia, are in ordinary type.

(only the arrangement of this family in the various classifications will be considered henceforth):—

Family III. Lycoperdaceae.

Sub-family 1. Podaxineae.

2. Diplodermeae.

Tylostoma, Queletia, Battarrea, Husseya, Mitremyces, Geaster, Diplocystis, Diploderma, Trichaster, Broomeia, Coilomyces.

3. Lycoperdeae.

Lanopila, Eriosphaeria, Bovista, Calvatia, Lycoperdon.

4. Sclerodermeae.

(*Mycenastrum* is placed here as a synonym of *Scleroderma*).

Ed. Fischer in Engler and Prantl's *Natuerliche Pflanzenfamilien*, I, 1\*\*, 1900, arranged the family as under:—

Order 3. Lycoperdineae.

Family I. Lycoperdaceae.

*Lycoperdon*, *Globaria*, *Catastoma* (= *Disciseda*), *Bovistella*, *Bovista*, *Mycenastrum*, *Geaster*.

Lloyd's classification (*Genera of the Gasteromycetes*, 1902) is as follows:—

Family 4. Lycoperdaceae.

Tribe 1. Tylostomeae.

2. Podaxineae.

3. Sclerodermeae.

4. Lycoperdeae.

Tribal Alliance i. Geastreae.

*Geaster*.

ii. Bovisteae.

*Bovista*, *Mycenastrum*, *Catastoma* (= *Disciseda*).

iii. Lycoperdeae.

*Bovistella*, *Lycoperdon*, *Calvatia*.

iv. Anomalae.

Gallacea, Castoreum, Arachnion, Mesophellia, Mitremyces.

Hollos (*Gasteromycetes Ungarns*, 1904), follows the arrangement:—

Family 3. Lycoperdaceae.

Battarrea, Tylostoma, Myriostoma, *Geaster*, *Astraeus*, *Calvatia*, *Lycoperdon*, *Disciseda*, *Bovista*, *Mycenastrum*.

Carleton Rea (*British Basidiomycetae*, 1922) arranges the family as under:—

Sub-order 3. Lycoperdineae.

Family 1. Lycoperdaceae.

*Lycoperdon*, *Bovistella*, *Bovista*, *Myriostoma*, *Geaster*.

From a consideration of these classifications we find that Persoon included *Battarrea*, *Tulostoma*, *Scleroderma* and the Myxomycetes in the family; that Saccardo placed *Geaster* in a separate sub-family, *Mycenastrum* as a synonym of *Scleroderma*, and included with *Lycoperdon*, etc. such genera as *Lanopila* and *Eriosphaeria*, while *Tulostoma*, *Mitremyces* (= *Calostoma*), etc. are placed in the sub-family Diplodermeae; that Fischer placed the genera later considered by the writer all under the Lycoperdaceae; that Hollos followed the older school in considering under the Lycoperdaceae such genera as *Battarrea*, *Tulostoma*, etc.; and that Rea's arrangement was similar to that of Fischer.

It is out of place to consider in detail the reasons why such genera as *Tulostoma*, *Battarrea*, *Scleroderma*, etc. do not belong to this family; these reasons will be given in subsequent papers dealing with these genera. As has been shown, the writer limits the family to those genera possessing a copious capillitium (which excludes *Scleroderma*); a non-stipitate peridium (which

excludes *Tulostoma* and *Battarrea*); 4- or 8-spored, sterigmate basidia (which excludes such genera as *Diploderma* and its allies).

All the genera considered as belonging to the family (*Abstoma*, *Bovista*, *Bovistella*, *Calvatia*, *Disciseda*, *Geaster*, *Lycoperdon*, *Mycenastrum* (extra-Australasian genera are not considered here) possess a two- or (in *Geaster*) four-layered peridium; the gleba is composed of spores immixed with copious capillitium threads; no stipe is present in any genus; the basidia are all long-sterigmate, and bear apically 4-8 unicellular spores. The development has been worked out for all genera by the writer, and is in most (save *Geaster*) found to be similar to that of *Lycoperdon*, save in minor details, as the formation of the capillitium threads.

#### STRUCTURAL SIMILARITIES AND DIFFERENCES IN THE GENERA OF THE LYCOPERDACEAE.

##### *Tribe Lycoperdeae.*

In the mature plant a two-layered peridium is always present, and the plants are attached to the substratum by a rooting base (*Bovistella* and *Lycoperdon*) which holds them to the place of origin even when old and withered; or they may be attached by a small rooting strand or mycelial cord and at maturity break away and be carried by the wind for some distance (*Abstoma*, *Bovista*, *Disciseda* and *Mycenastrum*).

The outer layer of the peridium is termed the exoperidium, and is usually pseudoparenchymatous, but may be membranous, and is often composed of warts and spines. This structure is often quite thin and flakes away in irregular patches. In *Abstoma* and *Disciseda* this membrane is frequently a thick (1-3 mm.) sand-case, consisting of loosely woven hyphae with which are immixed sand grains or particles of vegetable matter. The whole structure though firm is quite brittle, and falls away in irregular fragments. The exoperidium is one of the most variable tissues, ranging in the genus *Lycoperdon* from a smooth membrane, through furfuraceous to verrucose and even echinulate. The spines or verrucae seldom fall away completely but usually partly persist, especially towards the base. These structures are usually considered valuable aids in diagnosis, but should be used with caution, as in certain species individual plants in the same collection may possess either furfuraceous, verrucose or even echinulate processes to the exoperidium. In those species which are conspicuously spinose, the spines are usually surrounded at their bases with rings of small granules; consequently when the spines fall, the granules persist, giving to the exposed endoperidium a curiously reticulated appearance (*L. compactum*).

The inner tissue, the endoperidium, is in most genera thick and membranous or papyraceous, but in *Mycenastrum* is thick (2-5 mm.), corky, coriaceous and pseudoparenchymatous, and in growing plants often cartilaginous.

The peridium encloses the gleba, which at maturity consists of capillitium threads and spores. The threads serve as most useful generic characters. In many species of the genera *Bovistella* and *Lycoperdon* is present the so-called columella, a cylindrical or elliptical structure of sterile tissue traversing the lower portion of the gleba and attached to the base of the plant. In certain species of the genera *Bovistella*, *Calvatia* and *Lycoperdon* a sterile base is present. This consists of a usually cellular tissue occupying the lower portion of the gleba, and is most frequent in those plants with a well-developed, stem-like base. In two species (*Lycoperdon polymorphum* and *Calvatia candida*) the sterile base is not cellular but compact, and consequently frequently difficult to differentiate from

the gleba. In certain species of *Calvatia* and *Lycoperdon* (*Calvatia lilacina*, *C. caelata*, *Lycoperdon depressum*) the sterile base is separated from the gleba by a definite diaphragm.

The spores are continuous, globose or shortly elliptical, and possess rough or smooth epispores. Their shape, size and degree of roughness are useful specific characters. They may have long and slender sterigmata (often of irregular size on the same basidium) which in turn are borne apically on small cylindrical or clavate basidia. When the sterigmata with the attached spores break away from the basidia the latter are said to be pedicellate; when stumps only of the sterigmata remain attached to the spores the latter are said to be apiculate (though the use of this term is not strictly accurate, it being used generally in the sense of an apical point or apicula, the pedicel being basal); or should the spores become completely detached from the sterigmata they are said to be apedicellate. The basidia in all members of this tribe are regularly tetrasporous.

Most of the genera show a general resemblance, so close in fact that difficulty is sometimes experienced in separating species of *Bovistella* from *Lycoperdon* or *Bovista*. In the writer's experience separation is best effected by means of the capillitium threads, and method of dehiscence. In *Calvatia* and *Lycoperdon* the threads are very long, even throughout their length, sparingly septate or continuous. They are free at one end, and usually attached by the other to the inner wall of the peridium, or to the columella and diaphragm or sterile base should these be present. In *Lycoperdon* three types of capillitium threads are present; hyaline, septate, simple threads; coloured, continuous, simple or sparingly branched threads; and coloured, freely branched threads. These last approach in appearance those of *Bovista* and *Bovistella*.

*Calvatia* is separated from *Lycoperdon* chiefly by the method of dehiscence. In the former genus the upper portion of the peridium flakes away in pieces, when at maturity the whole may have disappeared, the gleba then being directly exposed. In *Lycoperdon* dehiscence is effected by a definite apical stoma. In two species (*L. depressum* and *L. Wrightii*) dehiscence is first effected by means of the apical stoma, but as the plant ages, irregular flaking away of the whole of the apex of the peridium occurs; consequently difficulty might be experienced in placing plants of these species, according to whether they were collected when mature or immature. In such cases the peculiar hyaline, septate capillitium serves to separate them.

In *Abstoma* and *Disciseda* the capillitium threads are very short, unbranched and usually continuous; and are so characteristic as usually to place any species in these two genera. Immature plants possess capillitium approaching the *Lycoperdon* or *Calvatia* type. In *Disciseda* dehiscence is effected by a stoma which in most species is apical but in one or two species is said to be basal. In *Abstoma* no stoma is present, the spores being liberated by irregular rupture of the endoperidium.

*Bovista* and *Bovistella* both possess capillitium threads which are peculiar and characteristic. Each thread is free, and has a short, distinct, thick main-stem, with numerous short, dichotomous, acuminate branches. The threads are penetrated to the lumen by peculiar conic pits (absent in *Bovista purpurea*). Dehiscence is effected by means of an apical stoma, as in *Lycoperdon*. The two genera are separated from one another upon habit, *Bovista* being a genus in which plants break away at maturity from the place of growth, *Bovistella* persisting by means of a rooting base as does *Lycoperdon*. Herbarium specimens may usually

be differentiated by the presence or absence of this rooting base. This in turn is usually indicated by the presence of a sterile base, so that by many workers, *Bovistella* has come to be recognized as a *Bovista* with a sterile base. In the opinion of the writer, however, this is not a sufficiently valid distinction upon which to base a genus.

*Mycenastrum* is characterized both by the capillitium threads and method of dehiscence. The threads are short, free, short-branched and covered with numerous spinous processes. Dehiscence is effected by the stellate splitting of the apex, but in certain forms, even in the same collection, it may be effected by the irregular breaking away of the apical portion.

*Tribe Geastreae.*

This is represented in Australasia by the single genus *Geaster*.

The structure of species of this genus differs in that no less than four well-defined tissues are present: (1) An outer mycelial layer consisting of a palisade of stout fibres; (2) a central fibrillose layer of interwoven hyphae with long axes predominantly radial; (3) an inner fleshy layer, definitely pseudoparenchymatous in structure (these three tissues comprise the exoperidium); and (4) the endoperidium.

The exoperidium splits into a variable number of rays, which may be expanded, revolute or involute. Dehiscence is effected by the exoperidium splitting from the apex downwards into several stellate lobes, exposing the endoperidium, which in turn dehisces by an apical stoma. The endoperidium is usually membranous or papyraceous, and may be carried on a short pedicel, or be sessile. The stoma may be a poorly defined aperture, scarcely discernible from the endoperidium—when it is said to be naked; or it may be enclosed within a definite peristome, when it is said to be peristomate. The peristome may be externally fluted, when it is termed plicate; or silky-fibrillose, when it is said to be fibrillose.

The capillitium threads are continuous, simple (save in *Geaster velutinus* where they are sometimes branched at their apices), thick-walled, acuminate pointed and dark-coloured. The basidia are usually 4-spored, but 8-spored forms are not uncommon. A columella is present in certain species, but is noticeable usually only in immature specimens immediately before dehiscence.

The spores are usually globose, usually some shade of brown, and mostly verrucose or verrucose-echinulate.

In the family Lycoperdaceae there are 57 Australasian species, distributed among the following eight genera: *Abstoma* 2, *Bovista* 2, *Bovistella* 3, *Calvatia* 4, *Disciseda* 8, *Geaster* 23, *Lycoperdon* 14, and *Mycenastrum* 1.

Their distribution is interesting, as the accompanying table shows.

*Table of Distribution of the Species.*

Species.	Distribution.
<i>Abstoma purpureum</i> .. .. .	New Zealand
<i>Abstoma reticulatum</i> .. .. .	Australia
<i>Bovista brunnea</i> .. .. .	New Zealand, Australia
<i>Bovista purpurea</i> .. .. .	New Zealand
<i>Bovistella bovistoides</i> .. .. .	New Zealand, Australia, India
<i>Bovistella pusilla</i> .. .. .	Australia
<i>Bovistella verrucosa</i> .. .. .	Australia



Species.	Distribution.
<i>Calvatia caelata</i> .. .. .	New Zealand, Australia, North America, Europe, Asia, Africa
<i>Calvatia candida</i> .. .. .	Australia, Europe
<i>Calvatia gigantea</i> .. .. .	New Zealand, Australia, North America, Europe
<i>Calvatia lilacina</i> .. .. .	New Zealand, Australia, North America, Europe, Africa
<i>Disciseda anomala</i> .. .. .	Australia
<i>Disciseda australis</i> .. .. .	Australia
<i>Disciseda candida</i> .. .. .	New Zealand, Australia, North America, Europe, South America
<i>Disciseda cervina</i> .. .. .	Australia, North America, Europe
<i>Disciseda hyalothrix</i> .. .. .	Australia
<i>Disciseda hypogaea</i> .. .. .	New Zealand, Australia
<i>Disciseda pedicellata</i> .. .. .	Australia, North America, Africa
<i>Disciseda verrucosa</i> .. .. .	New Zealand, Australia
<i>Geaster arenarius</i> .. .. .	Australia, North America
<i>Geaster australis</i> .. .. .	Australia
<i>Geaster Berkeleyi</i> .. .. .	Australia, Europe
<i>Geaster Bryantii</i> .. .. .	Australia, North America, Europe
<i>Geaster campester</i> .. .. .	Australia, North America, Europe
<i>Geaster Clelandii</i> .. .. .	Australia
<i>Geaster Drummondii</i> .. .. .	Australia
<i>Geaster ellipticus</i> .. .. .	Australia
<i>Geaster fenestriatus</i> .. .. .	Australia, North America, Europe, Africa
<i>Geaster fimbriatus</i> .. .. .	Australia, North America, Europe
<i>Geaster floriformis</i> .. .. .	New Zealand, Australia, North America, Europe, Africa
<i>Geaster Hariotii</i> .. .. .	Australia, Europe, Africa, South America
<i>Geaster limbatus</i> .. .. .	New Zealand, Australia, North America, Europe, Africa
<i>Geaster minus</i> .. .. .	New Zealand, Australia, North America, Europe, Asia
<i>Geaster mirabilis</i> .. .. .	Australia, North America, Asia, South America
<i>Geaster pectinatus</i> .. .. .	New Zealand, Australia, North America, Europe
<i>Geaster plicatus</i> .. .. .	New Zealand, Australia, Africa, India
<i>Geaster saccatus</i> .. .. .	Australia, North America, Europe, South America
<i>Geaster simulans</i> .. .. .	Australia
<i>Geaster Smithii</i> .. .. .	Australia, North America
<i>Geaster subiculosus</i> .. .. .	Australia
<i>Geaster triplex</i> .. .. .	New Zealand, Australia, North America, Europe, South America
<i>Geaster velutinus</i> .. .. .	New Zealand, Australia, North America, Africa, South America
<i>Lycoperdon asperum</i> .. .. .	Australia, Africa, South America
<i>Lycoperdon compactum</i> .. .. .	New Zealand
<i>Lycoperdon depressum</i> .. .. .	New Zealand, Australia, Europe, Africa
<i>Lycoperdon glabrescens</i> .. .. .	New Zealand, Australia
<i>Lycoperdon Gunnii</i> .. .. .	Australia
<i>Lycoperdon nitidum</i> .. .. .	Australia
<i>Lycoperdon perlatum</i> .. .. .	New Zealand, Australia, North America, Europe, Africa, South America, India
<i>Lycoperdon piriforme</i> .. .. .	New Zealand, Australia, North America, Europe, South America, Asia
<i>Lycoperdon polymorphum</i> .. .. .	New Zealand, Australia, North America, Europe, Africa
<i>Lycoperdon pusillum</i> .. .. .	New Zealand, Australia, North America, Europe, Africa, Asia, India
<i>Lycoperdon scabrum</i> .. .. .	New Zealand, Australia
<i>Lycoperdon spadiceum</i> .. .. .	New Zealand, Australia, Europe
<i>Lycoperdon stellatum</i> .. .. .	Australia
<i>Lycoperdon subincarnatum</i> .. .. .	Australia, North America
<i>Mycenastrum corium</i> .. .. .	New Zealand, Australia, North America, Europe, Africa, Asia, India

This table shows that of these 57 species, 27 occur in New Zealand; 54 in Australia; 24 in Europe; 14 in Africa; 5 in India; 26 in North America; 9 in South America; 6 in Asia; 23 being confined to this biological region.

In the genus *Geaster* (and the related extra-Australian genus *Myriostoma*) are certain structural differences that separate it from the other genera placed in

the family. Consequently the family may conveniently be divided into the two following tribes:—

Tribe Lycoperdeae: Peridium two-layered, dehiscing by an apical stoma or by the gradual falling away of the upper portions of the peridium; capillitium attached or free, simple or freely branched; basidia sterigmate, 4-spored.

Tribe Geastreae: Peridium four-layered, dehiscing by the exoperidium splitting from the apex downwards in a stellate manner exposing the endoperidium, which in turn dehisces by means of an apical stoma; capillitium attached, simple; basidia sterigmate 4-8 spored.

The genera may be arranged as under:—

*Key to the Genera.*

Tribe Lycoperdeae: Peridium 2-layered; basidia 4-spored.

Capillitium threads attached to the endoperidium and central columella, when present.

Peridium dehiscing by irregular apical rupture ..... 1. *Calvatia*.

Peridium dehiscing by a definite apical stoma ..... 2. *Lycoperdon*.

Capillitium threads free within the endoperidium.

Threads simple, or short-branched.

Threads short, simple, smooth.

Stoma present, apical or basal ..... 5. *Disciseda*.

Stoma absent ..... 6. *Abstoma*.

Threads short, simple, spinose ..... 7. *Mycenastrum*.

Threads freely branched, of a central main stem, and short, dichotomous, acuminate branches.

Plants with a strong rooting base ..... 3. *Bovistella*.

Plants without a definite rooting base ..... 4. *Bovista*.

Tribe Geastreae: Peridium 4-layered; basidia 4-8 spored.

Peridium with a solitary apical stoma ..... 8. *Geaster*.

In order to bring all species of the family together, the following keys to the species of each genus have been given.

1. CALVATIA Fries.

(For emended descriptions, see PROC. LINN. SOC. N.S.W., 1926, li, p. 363.)

Diaphragm present.

Spores smooth ..... *C. caelata* (Bull.) Morg.

Spores verrucose ..... *C. lilacina* (B. et M.) Lloyd

Diaphragm absent.

Plants large, exterior smooth and leathery .... *C. gigantea* (Pers.) G. H. Cunn.

Plants small, exoperidium furfuraceous ..... *C. candida* (Rostk.) Hollos

2. LYCOPERDON Tourn.

(Descriptions, PROC. LINN. SOC. N.S.W., 1926, li, p. 627.)

Spores without distinct pedicels.

Capillitium hyaline, freely septate.

Diaphragm present ..... *L. depressum* Bon.

Diaphragm absent.

Exoperidium with minute depressions ..... *L. subincarnatum* Peck

Exoperidium reticulate with persistent granules .....

..... *L. compactum* G. H. Cunn.

Capillitium coloured, usually continuous.

Capillitium continuous or sparingly branched.

Sterile base of large cells, 2 mm. or more.

Exoperidium of minute connivent spines .... *L. piriforme* Schaeff.

Exoperidium of pointed verrucae ..... *L. perlatum* Pers.

Sterile base of minute cells, 1 mm. or less.

Exoperidium of large cruciate spines .... *L. stellatum* Cke. et Mass.

Exoperidium furfuraceous ..... *L. nitidum* Lloyd

Capillitium freely branched.

Sterile base cellular ..... *L. spadiceum* Pers.

Sterile base compact ..... *L. polymorphum* Vitt.

Sterile base absent ..... *L. pusillum* Pers.

- Spores long pedicellate.  
Sterile base well developed.  
Exoperidium furfuraceous ..... *L. glabrescens* Berk.  
Exoperidium of cruciate spines ..... *L. scabrum* (Lloyd) G. H. Cunn.  
Sterile base scanty or absent.  
Exoperidium of pallid cruciate spines ..... *L. asperum* (Lev.) de Toni.  
Exoperidium furfuraceous or tomentose ..... *L. Gunnii* Berk.
3. BOVISTELLA Morg.  
(Descriptions, PROC. LINN. SOC. N.S.W., 1925, 1, p. 370.)  
Spores long pedicellate.  
Peridium pallid tan, finely tomentose ..... *B. verrucosa* G. H. Cunn.  
Peridium dark brown, areolate ..... *B. bovistoides* (C. et M.) Lloyd  
Spores apedicellate ..... *B. pusilla* Lloyd
4. BOVISTA Dill., ex Persoon.  
(Descriptions, PROC. LINN. SOC. N.S.W., 1925, 1, p. 369.)  
Capillitium pitted ..... *B. brunnea* Berk.  
Capillitium not pitted ..... *B. purpurea* Lloyd
5. DISCISEDA Czern.  
(Descriptions, PROC. LINN. SOC. N.S.W., 1927, lii, p. 236.)  
Spores long pedicellate.  
Spores strongly verrucose ..... *D. pedicellata* (Morg.) Hollos.  
Spores verrucose-areolate ..... *D. hyalothrix* (C. et M.) Hollos.  
Spores apedicellate (or apiculate, stumps only of pedicels persisting).  
Spores almost smooth ..... *D. candida* (Schw.) Lloyd  
Spores finely verruculose.  
Stoma fimbriate-mammose ..... *D. cervina* (Berk.) G. H. Cunn.  
Stoma tubular, surrounded by a depressed groove.  
Spores finely verrucose-echinulate .. *D. anomala* (C. et M.) G. H. Cunn.  
Spores covered with fine round-topped warts .. *D. australis* G. H. Cunn.  
Spores coarsely verrucose.  
Spores covered with flat-topped echinulations .....  
..... *D. hypogaea* (C. et M.) G. H. Cunn.  
Spores covered with coarse verrucae ..... *D. verrucosa* G. H. Cunn.
6. ABSTOMA G. H. Cunn.  
(Descriptions, PROC. LINN. SOC. N.S.W., 1927, lii, p. 241.)  
Gleba purple; spores finely reticulate ..... *A. purpureum* (Lloyd) G. H. Cunn.  
Gleba olivaceous; spores coarsely reticulate ..... *A. reticulatum* G. H. Cunn.
7. MYCENASTRUM Desv.  
(Description, PROC. LINN. SOC. N.S.W., 1927, lii, p. 245) .. *M. corium* (Guers.) Desv.
8. GEASTER Mich.  
(Descriptions, PROC. LINN. SOC. N.S.W., 1926, li, p. 76.)  
Mouth peristomate.  
Peristome sulcate.  
Exoperidium not hygroscopic.  
Endoperidium pedicellate.  
Endoperidium smooth (or farinose, not roughened).  
Peristome circular.  
Base of the endoperidium smooth or striate .....  
..... *G. pectinatus* (Pers.) Lloyd  
Base of the endoperidium plicate ..... *G. plicatus* Berk.  
Base of the endoperidium with a collar-like ring .....  
..... *G. Bryantii* Berk.  
Peristome elliptical ..... *G. ellipticus* G. H. Cunn.  
Endoperidium roughened-verrucose.  
Peristome concolorous ..... *G. Hariotii* Lloyd  
Peristome surrounded by a silky, differently coloured zone ....  
..... *G. Berkeleyi* Mass.  
Endoperidium sessile or sub-pedicellate (*G. Hariotii*).

- Exoperidium hygroscopic.  
 Endoperidium pedicellate.  
     Spores 6-8  $\mu$  diam. .... *G. campester* Morg.  
     Spores 4-5.5  $\mu$  diam.  
         Endoperidium asperate ..... *G. Clelandii* Lloyd  
         Endoperidium smooth ..... *G. Smithii* Lloyd  
     Endoperidium typically sessile ..... *G. Drummondii* Berk.
- Peristome fibrillose.  
 Exoperidium not hygroscopic.  
 Endoperidium pedicellate.  
     Plants typically minute ..... *G. minus* (Pers.) G. H. Cunn.  
     Plants typically large ..... *G. limbatus* Fries  
 Endoperidium sessile.  
     Exoperidium externally felted-tomentose or tomentose-strigose.  
         Plants large, 3-6 cm. .... *G. velutinus* Morg.  
         Plants small, 1.5-2 cm. .... *G. mirabilis* Mont.  
     Exoperidium externally smooth, or almost so.  
         Spores smooth or nearly so .... *G. subiculosus* Cke. et Mass.  
         Spores verrucose-echinulate or verrucose.  
             Spores 2.5-3.5  $\mu$  diam. .... *G. saccatus* Fries  
             Spores 4-5  $\mu$  diam. .... *G. triplex* Jungh.  
             Spores 7-8  $\mu$  diam. .... *G. australis* Berk.
- Exoperidium hygroscopic.  
 Endoperidium pedicellate ..... *G. arenarius* Lloyd  
 Endoperidium sessile ..... (*G. mammosus*)
- Mouth naked.  
 Exoperidium not hygroscopic.  
 Endoperidium pedicellate.  
     Exoperidium typically fornicate .... *G. fenestriatus* (Pers.) G. H. Cunn.  
     Exoperidium revolute ..... (*G. rufescens*)  
 Endoperidium sessile ..... *G. fimbriatus* Fries
- Exoperidium hygroscopic.  
     Spores 6-7  $\mu$  diam. .... *G. floriformis* Vitt.  
     Spores 4-5  $\mu$  diam. .... *G. simulans* Lloyd

*Synonyms Recorded in Australasian Literature.*

*Bovista*

- |                                      |                                     |
|--------------------------------------|-------------------------------------|
| <i>anomala</i> Cke. et Mass.         | = <i>Disciseda anomala</i>          |
| <i>argillacea</i> Pat.               | = <i>Disciseda cervina</i>          |
| <i>aspera</i> Lev.                   | = <i>Lycoperdon asperum</i>         |
| <i>candida</i> Schw.                 | = <i>Disciseda candida</i>          |
| <i>cervina</i> Berk.                 | = <i>Disciseda cervina</i>          |
| <i>circumscissa</i> Berk. et Curt.   | = <i>Disciseda candida</i>          |
| <i>debreciensis</i> (Hazsl.) de Toni | = <i>Disciseda cervina</i>          |
| <i>gigantea</i> (Pers.) Nees         | = <i>Calvatia gigantea</i>          |
| <i>hyalothrix</i> Cke. et Mass       | = <i>Disciseda hyalothrix</i>       |
| <i>hypogaea</i> Cke. et Mass.        | = <i>Disciseda hypogaea</i>         |
| <i>lilacina</i> Berk. et Mont.       | = <i>Calvatia caelata</i>           |
| <i>Muelleri</i> Berk.                | = <i>Disciseda Muelleri</i>         |
| <i>olivacea</i> Cke. et Mass.        | = <i>Calvatia candida</i>           |
| <i>ovalispora</i> Cke. et Mass.      | = <i>Bovista brunnea</i> , probably |
| <i>pusilla</i> Pers.                 | = <i>Lycoperdon pusillum</i>        |
| <i>suberosa</i> Fries                | = <i>Mycenastrum corium</i>         |
| <i>subterranea</i> Peck              | = <i>Disciseda cervina</i>          |
| <i>tomentosa</i> Vitt.               | = Misdetermination                  |
| <i>tunicata</i> Bon.                 | = <i>Calvatia candida</i>           |

*Bovistella*

- |                                  |                                 |
|----------------------------------|---------------------------------|
| <i>aspera</i> (Lev.) Lloyd       | = <i>Lycoperdon asperum</i>     |
| <i>australiana</i> Lloyd         | = <i>Lycoperdon glabrescens</i> |
| <i>cuprica</i> Lloyd             | = <i>Nomen nudum</i>            |
| <i>glabrescens</i> (Berk.) Lloyd | = <i>Lycoperdon glabrescens</i> |
| <i>Gunnii</i> (Berk.) Lloyd      | = <i>Lycoperdon Gunnii</i>      |
| <i>nigrica</i> Lloyd             | = <i>Lycoperdon scabrum</i>     |
| <i>rosea</i> Lloyd               | = <i>Lycoperdon glabrescens</i> |
| <i>scabra</i> Lloyd              | = <i>Lycoperdon scabrum</i>     |

*Calvatia*

<i>aurea</i> Lloyd	= <i>Calvatia candida</i> var. <i>rubro-flava</i>
<i>cyathiformis</i> (Bosc.) Morg.	= <i>Calvatia lilacina</i>
<i>favosum</i> (Bon.) Lloyd	= <i>Calvatia caelata</i>
<i>Fontanesii</i> (Dur. et Mont.) Lloyd	= <i>Calvatia caelata</i>
<i>maxima</i> (Schaeff.) Morg.	= <i>Calvatia gigantea</i>
<i>occidentalis</i> Lloyd	= <i>Calvatia candida</i>
<i>olivacea</i> (Cke. et Mass.) Lloyd	= <i>Calvatia candida</i>
<i>primitiva</i> Lloyd	= <i>Calvatia gigantea</i>
<i>rubro-flava</i> (Cragin) Lloyd	= <i>Calvatia candida</i> var. <i>rubro-flava</i>
<i>Sinclairii</i> (Berk.) Lloyd	= <i>Calvatia caelata</i>

*Cycloderma*

<i>ohiense</i> Cke.	= <i>Geaster velutinus</i>
<i>platyspora</i> Cke. et Mass.	= <i>Geaster velutinus</i>

*Catastoma*

<i>anomalum</i> (Cke. et Mass.) Lloyd	= <i>Disciseda anomala</i>
<i>circumscissa</i> (B. et C.) Morg.	= <i>Disciseda candida</i>
<i>debreciensis</i> (Hazsl.) Hollos	= <i>Disciseda cervina</i>
<i>hyalothrix</i> (C. et M.) Lloyd	= <i>Disciseda hyalothrix</i>
<i>hypogaea</i> (C. et M.) Lloyd	= <i>Disciseda hypogaea</i>
<i>magnum</i> Lloyd	= <i>Nomen nudum</i>
<i>Muelleri</i> (Berk.) Lloyd	= <i>Disciseda Muelleri</i>
<i>pedicellata</i> Morg.	= <i>Disciseda pedicellata</i>
<i>purpurea</i> Lloyd	= <i>Abstoma purpureum</i>
<i>subterranea</i> (Peck) Morg.	= <i>Disciseda cervina</i>

*Disciseda*

<i>circumscissa</i> (B. et C.) Hollos	= <i>Disciseda candida</i>
<i>debreciensis</i> (Hazsl.) Hollos	= <i>Disciseda cervina</i>

*Geaster*

<i>affinis</i> Col.	= <i>Geaster triplex</i> , probably
<i>Archeri</i> Berk.	= <i>Geaster triplex</i>
<i>argenteus</i> Cke.	= Misdetermination
<i>asper</i> (Mich.) Lloyd	= <i>Geaster campester</i>
<i>biplicatus</i> Berk. et Curt.	= <i>Geaster plicatus</i>
<i>caespitosus</i> Lloyd	= <i>Geaster mirabilis</i>
<i>calceus</i> Lloyd	= <i>Geaster minus</i>
<i>coriaceus</i> Col.	= <i>Geaster triplex</i>
<i>coronatus</i> Col.	= <i>Geaster triplex</i> , probably
<i>coronatus</i> (Schaeff.) Lloyd	= <i>Geaster minus</i>
<i>delicatus</i> Morg.	= <i>Geaster floriformis</i>
<i>dubius</i> Berk.	= <i>Geaster velutinus</i>
<i>Englerianus</i> Henn.	= <i>Geaster triplex</i>
<i>fornicatus</i> (Huds.) Fr.	= <i>Geaster fenestriatus</i>
<i>fornicatus</i> Fr.	= <i>Geaster minus</i>
<i>granulosus</i> Fcl.	= <i>Geaster minus</i>
<i>hungaricus</i> Hollos	= <i>Geaster floriformis</i>
<i>hygrometricus</i> (Pers.) Fr.	= Misdetermination
<i>involutus</i> Mass.	= <i>Geaster Drummondii</i>
<i>lageniformis</i> Vitt.	= <i>Geaster triplex</i>
<i>lignicola</i> Berk.	= <i>Geaster mirabilis</i>
<i>Lloydii</i> Bres. et Pat.	= <i>Geaster velutinus</i>
<i>marginatus</i> Vitt.	= <i>Geaster minus</i>
<i>minus</i> (Schw.) Lloyd	= <i>Geaster minus</i>
<i>Morganii</i> Lloyd	= <i>Geaster triplex</i>
<i>orientalis</i> Hazsl.	= <i>Geaster Bryantii</i>
<i>pseudomammosus</i> Hollos.	= <i>Geaster campester</i>
<i>Readeri</i> Cke. et Mass.	= <i>Geaster velutinus</i>
<i>Schmideli</i> Vitt.	= <i>Geaster pectinatus</i>
<i>striatus</i> Fr.	= <i>Geaster pectinatus</i>
<i>striatulus</i> Kalch et Cke.	= <i>Geaster Drummondii</i>
<i>tenuipes</i> Berk.	= <i>Geaster plicatus</i>



Cunningham, G H. 1927. "The Gasteromycetes of Australasia. IX. Keys to the genera and species of the Lycoperdaceae." *Proceedings of the Linnean Society of New South Wales* 52, 247–257.

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